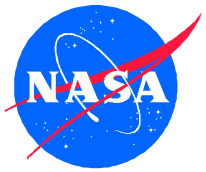

HWCI 3.3.1.1
TDRSS Transponder

- Requirements Traceability
  - DTRD sections 3.3.1.1, 3.3.2.1
- Trade Studies
  - Space qualified transponders
  - Balloon qualified transponders
- HWCI Description
  - New procurement by NSBF for balloon-class transponder for LDB and ULDB use
  - Awarded to Motorola 10/98
  - Functionally equivalent to Motorola fourth generation space qualified transponder
  - Supports MA and SSA modes of operation

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HWCI 3.3.1.1
TDRSS Transponder

- HWCI Description (cont.)
  - 1553 interface for transponder monitor and control Risk Assessment & Mitigation/Reliability
    - Previous Flight History
    - COTS
  - Command rate 125 bps, Return Link rates up to 150 kbps supported
  - RF output power 5 watts
  - Input power 6.5 watts receive, 32 watts transmit
  - Operating temperature range -10 to 55 C

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HWCI 3.3.1.1
TDRSS Transponder

- Risk Mitigation/Reliability
  - Based on fourth generation space qualified units
  - First generation balloon-class transponders available
  - Available units as option on fourth generation space qualified contract
    - Can “plug and play”
  - One of two global communication systems flown capable of supporting mission operations data and command
  - Science data recorded on-board

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HWCI 3.3.1.2
TDRSS Low Gain Antenna

- Requirements Traceability
  - DTRD sections 3.3.1.2, 3.3.1.3, 3.3.2
- Trade Studies
  - in-house fabrication
  - commercial supplier
- Functional and Performance Requirements
  - Provide maximum VSWR of 1.5:1
  - Provide omni-directional gain pattern in azimuth
  - Provide 0 dB gain +5, -1 dB at elevation angles from -6 to +80 degrees
  - Provide greater than -5 dB gain at elevation angles from 80 to 90 degrees
  - Maintain functionality and structural integrity in exposed ULDB flight environment for mission duration

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HWCI 3.3.1.2
TDRSS Low Gain Antenna

- HWCI Description
  - Quadrifilar helix antenna designed and constructed by Code 567
  - LHCP
  - < 1 lb.
  - 1 foot height, 5 inch diameter cylindrical radome
  - Replication of design successfully flown on LDB
- Risk Assessment & Mitigation/Reliability
  - Successfully flown on LDB
  - Backup to TDRSS pointed antenna
  - Supports one of two global communication systems

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HWCI 3.3.1.6
TDRSS Data Interface

- Requirements Traceability
  - DTRD Section 3.3.1.1
- Trade Studies
  - In-house build or contractor
- Functional and Performance Requirements
  - The board shall provide two serial data streams compatible with the I and Q inputs on the TDRSS transponder
  - The serial data streams shall conform to the TDRSS users guide requirements
  - The board shall support multiple bit rates
  - The board shall support “combined I and Q” mode
  - The board shall interface to the PC104 bus for data transfer from the flight processors

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HWCI 3.3.1.6
TDRSS Data Interface

- HWCI Description
  - PC104 custom card designed and fabrication by WFF
  - 64K x 8 bit deep FIFO (IDT 7208)
  - half full flag used to interrupt flight processor
  - Designed to support up to 150 kbps
- Risk Assessment & Mitigation/Reliability
  - Redundant subsystem
    - Each flight processor has interface board
  - Graceful degradation
    - Each board has independent I&Q circuitry, can operate with only one functional

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HWCI 3.3.2.1 & 3.3.2.2
INMARSAT transceiver and antenna

- Requirements Traceability
  - DTRD section 3.3.1.3, 3.3.2.2
- Trade Studies
  - Commercial, Military and Government communications satellites
    - Inmarsat only mature commercial bi-directional global data communications system
- Functional and Performance Requirements
  - The subsystem shall transmit data and receive commands via the INMARSAT network
  - The subsystem shall meet or exceed all INMARSAT specifications for the Inmarsat-C Network

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HWCI 3.3.2.1 & 3.3.2.2 INMARSAT transceiver and antenna

- HWCI Description
  - Inmarsat support four “ocean regions” of coverage
  - Terminal transmit in 1626.5 to 1646.5 MHz band
  - Terminal receives in 1530 to 1545 band
  - Data rate is 600 bps
  - Transmission are message based - 32kB maximum
  - Input power 80 w during transmit, 9.5 w during receive
  - Terminal operating temperature range -25 C to 55 C
  - Antenna operating temperature range -35 C to 55 C
  - EIRP 14 dBW +/- 2 dB at 5 degrees elevation
- Risk Assessment & Mitigation/Reliability
  - Subsystem is backup global communications system
  - Same model hardware successfully flown on LDB Balloon flights from Antarctica and Alaska

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HWCI 3.3.6.1 & 3.3.6.2
Iridium - Orbcomm transceivers/antennas

- Requirements Traceability
  - DTRD section 3.3.1.3, 3.3.2.2
- Trade Studies
  - Commercial, Military and Government communications satellites
    - Iridium and Orbcomm only (other than Inmarsat) commercial bi-directional global data communication systems nearly deployed
- Functional and Performance Requirements
  - The subsystem shall support global uplink and downlink through commercial communications provider
  - The subsystem shall support data and command interfaces to the flight processors

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HWCI 3.3.6.1 & 3.3.6.2
Iridium - Orbcomm transceivers/antennas

- Iridium Description
  - 66 Satellite constellation complete
  - Commercial voice service delayed from 9/23/98 to 11/1/98
  - Commercial data service delayed to “mid 1999”
  - 2400 bps at L band
  - Handheld voice transceivers with data connection available now - not viable
  - Modified Motorola transceiver under development by NAL Research Corporation
    - Information is currently Proprietary
    - NAL working with Motorola and Iridium

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HWCI 3.3.6.1 & 3.3.6.2
Iridium - Orbcomm transceivers/antennas

- Orbcomm Description
  - 16 operating satellites currently, 9 more by end of year
  - Commercial data service available now
  - 2400 bps at L band
  - "Globalgram mode" with 200 byte message would meet mission operations requirements
  - FCC approval for airborne application needed
  - Data latency high due to lack of ground stations
  - Magellan GSC-100, Panasonic KX-G7001 and Scientific Atlanta evaluated for ULDB application
  - Panasonic model selected for further development

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HWCI 3.3.6.1 & 3.3.6.2
Iridium - Orbcomm transceivers/antennas

- Orbcomm Transceiver
- Panasonic KX-G7001
  - 1.3 kg, 7.3 x 5.9 x 2.4 inches
  - integrated GPS optional
  - serial RS-232C communications port
  - 2400 bps return link, 4800 bps forward link
  - 148 to 150 MHz return link, 137 to 138 MHz forward link
  - Input power 2.4 w receive, 36 w transmit with half-wave whip antenna
  - Operating Temperature range -40 to 75 C

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